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THE EFFECTS OF SIGNALING STIMULUS PRESENTATION DURING NONCONTINGENT REINFORCEMENT

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The effects of signaling the return of items or attention during treatment with noncontingent reinforcement were examined. First, functional analyses showed that the problem behavior exhibited by 2 teenagers with developmental disabilities was sensitive to social positive reinforcement. Next, delivery of the stimulus that maintained problem behavior on a fixed-time (FT) schedule was compared to a condition in which the removal of the stimulus during the same FT schedule was immediately preceded by a statement indicating that the stimulus would be returned and the initiation of a digital timer. Results show that the FT schedule reduced problem behavior, and the addition of an informative statement and a timer further decreased problem behavior.

DESCRIPTORS: functional analysis, noncontingent reinforcement, delay to reinforcement, signals, fixed-time schedules

Noncontingent reinforcement (NCR) is the delivery of a reinforcer on a time-based schedule, independent of responding. NCR has been shown to be an effective treatment for a variety of behavior problems exhibited by individuals with developmental disabilities. In addition, NCR may preclude some of the unwanted side effects of other behavioral interventions (e.g., differential reinforcement of other behavior) (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993).

A number of methods for enhancing the effects of NCR have been examined. For example, Carr, Bailey, Ecott, Lucker, and Weil (1998) and Roscoe, Iwata, and Rand (2003) found that high-magnitude NCR schedules produced greater reductions in behavior than did low-magnitude schedules. Also, Hagopian, Fisher, and Legacy (1994) found that dense NCR schedules were more effective in decreasing destructive behavior than were lean NCR schedules and that lean schedules could be effective after schedule thinning.

Another method of enhancing NCR effects involves the signaling of stimuli delivered during NCR. Mace, Shapiro, and Mace (1998) showed that four warning stimuli delivered 30 s apart during the 2 min immediately before a preferred item was removed or a demand was presented during NCR (plus extinction) reduced self-injury to a greater extent than NCR (plus extinction) with a single warning delivered 2 min before the events or NCR (plus extinction) without warnings. In addition to signaling reinforcer cessation, as in

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the Mace et al. investigation, it might be possible to enhance NCR by signaling reinforcer delivery. Thus, in the current study, we compared NCR (plus extinction) to NCR (plus extinction) and the delivery of a signal indicating the next reinforcer delivery.

METHOD

Participants and Setting

Two teenagers from a community-based group home participated in the study. Sam was a 19-year-old man who had been diagnosed with impulsive control disorder (not otherwise specified), profound metal retardation, autism, and seizure disorder. Sam needed physical assistance and prompting to complete his hygiene skills. He could follow two- to three-step instructions and had a limited number of vocal mands in his repertoire. Tina was a 16-year-old girl who had been diagnosed with mood disorder, posttraumatic stress disorder, attention deficit hyperactivity disorder, and mental retardation. She was fully independent in all of her personal hygiene skills (e.g., bathing, toileting) and had good language skills. That is, she could follow multistep instructions, and she had a large number of vocal mands in her repertoire. All sessions were conducted in the participants' private rooms in their group home.

Response Definitions and Interobserver Agreement

The dependent variable for Sam was *aggression*, which was defined as hitting, kicking, biting, slapping, pinching, scratching or throwing items at the therapist. For Tina, the dependent variable was *inappropriate interruption*, which was defined as speaking to a therapist when the therapist was conversing with another person. A list of topics that Tina often spoke about was generated with the help of group home staff. These topics were discussed during her sessions.

All sessions were 10 min in duration; three to six sessions were conducted per day, 2 to 3 days per week. For Sam, data were collected on frequency of aggression and were later converted into a rate measure (i.e., aggression per minute). A 10-s partial-interval recording procedure was used to record Tina's interruptions. Two independent observers collected data during 17% and 45% of functional analyses and NCR evaluations for Sam and Tina, respectively. For Sam, agreement was calculated by dividing each session into 1-min intervals, dividing the smaller number of target behaviors by the larger for each interval, and averaging these to obtain a session agreement score. If both observers recorded no responses for an interval, that interval was scored as 100% agreement. Mean agreement for Sam was 91% (range, 76% to 100%). For Tina, overall, occurrence, and nonoccurrence agreements were calculated by dividing the number of agreements by the number of disagreements plus agreements and multiplying by 100%. Mean overall, occurrence, and nonoccurrence agreements for Tina were 95% (range, 90% to 100%), 86% (range, 68% to 100%), and 93% (range, 88% to 100%), respectively.

Experimental Design

Multielement designs were used during the functional analysis for both Sam and Tina. A reversal ABACABAC design was used during the NCR evaluation for Sam. The conditions were A (baseline), B (NCR), and C (NCR with signal). A combination reversal and multielement design was used during the NCR evaluation for Tina.

Procedure

Functional analysis. First, a functional analysis was conducted for both participants. Sam's functional analysis was similar to those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994) except that it included tangible and ignore conditions (in addition to demand, social attention, and toy-play conditions). The ignore condition was similar to an alone condition, except that the therapist was in

the room with the participant. During the tangible condition, which was included based on the results of a previous informant assessment, the therapist delivered a preferred toy (identified via a multiple-stimulus preference assessment) to the participant for 30 s contingent on each occurrence of the target behavior. An extended comparison of the tangible and control conditions was conducted after each of the five conditions had been conducted once.

Tina's functional analysis was conducted in a pairwise format, in which the attention and control conditions of the functional analysis were randomly alternated. The control condition consisted of a therapist and his partner engaging in a reciprocal conversation with Tina and each other for the duration of the session. Although the therapist and his partner did speak to Tina intermittently during the control condition, there were also times during which Tina was not being directly spoken to, allowing the possibility of interruption. In the attention condition, a therapist and a partner spoke to each other and, contingent on an interruption by Tina, the therapist spoke to her for 10 s.

NCR evaluation. For Sam, the item used during the tangible condition of the functional analysis was used during NCR evaluations. However, his preference for the item seemed to wane (i.e., between sessions he did not mand for the item as he had in the past, but did approach and mand for other items), so additional preference assessments were conducted immediately before every two to three sessions across baseline and NCR phases. The first item chosen during each preference assessment was used during the subsequent two or three sessions. This was done to ensure that the item used during the various baseline and NCR phases remained highly preferred for the duration of the study.

The results of the functional analysis for Sam suggested that his behavior was maintained by access to tangible items. Thus, the baseline phase was identical to the tangible condition of the functional analysis. In the NCR phase, a preferred tangible item was delivered on a fixed-time (FT) 30-s schedule, which was derived from the mean latency (rounded to the nearest 5 s) to the first response during baseline (Lalli, Casey, & Kates, 1997). After 30 s, the therapist removed the item without saying anything to Sam. Aggression did not result in access to the item. The NCR plus signal (NCR/S) phase was identical to the NCR phase, except that immediately before the therapist removed the toy, he said, "Sam, I am taking the toy. When the timer rings, I will give it back to you." A digital timer was then set for 30 s and placed within Sam's view. When the time expired, the therapist returned the toy to Sam for 30 s and said nothing. This was done each time the therapist removed the toy. Problem behavior did not result in toy delivery.

The results of the functional analysis for Tina suggested that her interruptions were maintained by access to therapist attention. Thus, her baseline phase was identical to the attention condition of the functional analysis. In the NCR condition, the therapist and a partner were in the room with the participant. The therapist conversed with his partner. The therapist delivered attention (in the form of a 5- to 8-s statement) to Tina on an FT 10-s schedule. The FT schedule was calculated in the same manner as it was for Sam. Interruption did not result in attention. Noncontingent reinforcement and NCR/S were randomly alternated in this phase. The NCR/S condition was identical to the NCR condition, except that immediately before the therapist began conversing with his partner (which was also immediately after he attended to Tina), he said, "Tina, I am going to talk to Mike and when the timer rings, I will speak to you." A digital timer was then set for 10 s and placed in Tina's view. Next, the therapist spoke to Mike for 10 s. When the time expired, the therapist spoke to Tina for 10 s. The statement and timer were used at the end of every 10-s delivery of

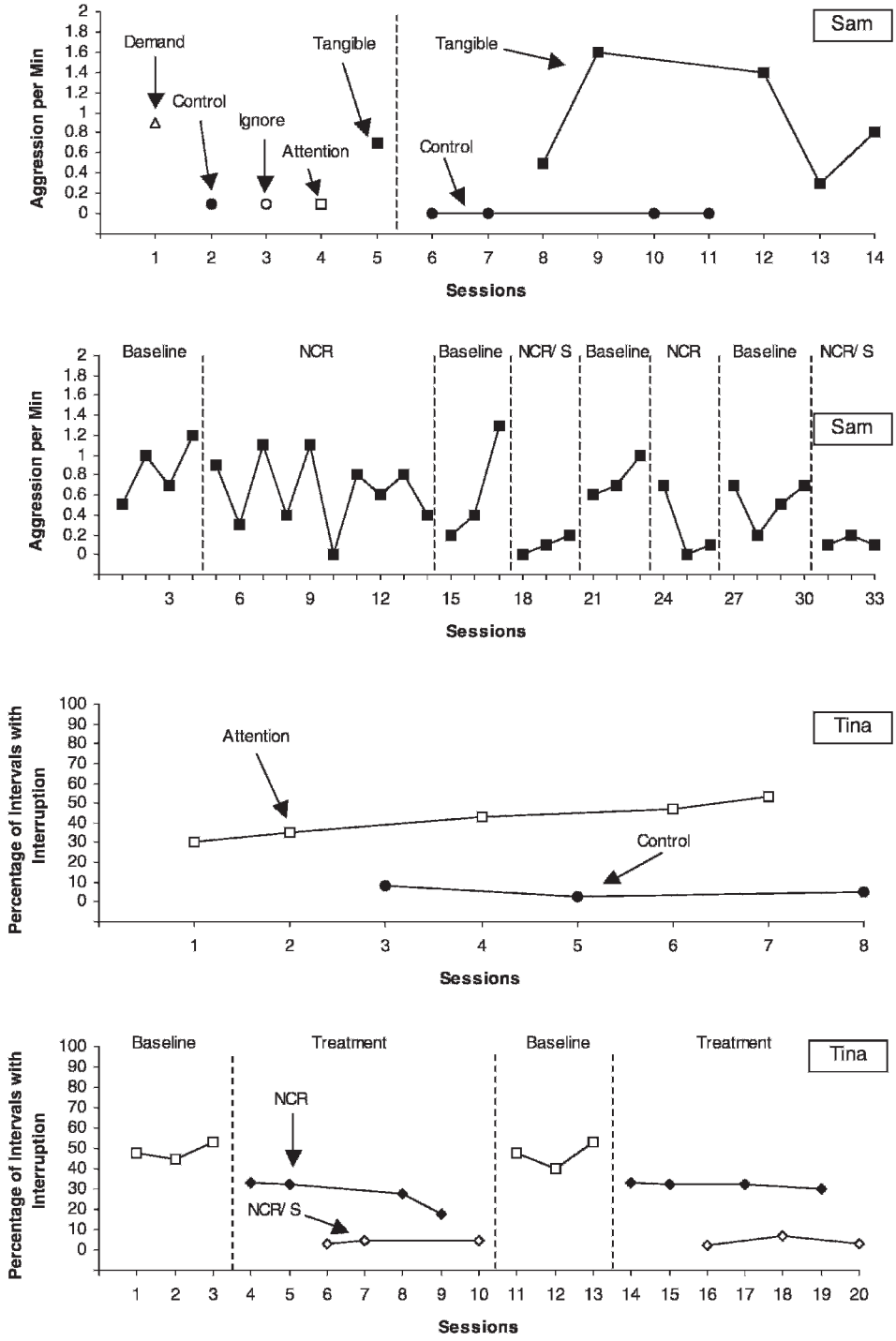

Figure 1. Results of the functional analysis (top) and NCR evaluation (bottom) for Sam and Tina.

attention. Problem behavior did not result in attention.

RESULTS AND DISCUSSION

Results are presented in Figure 1. Sam's mean rates of aggression during the functional analysis were 0.9, 0.1, 0.1, 0.1, and 0.7 per minute in the demand, control, ignore, attention, and tangible conditions, respectively. These data suggest that aggression was maintained by both escape from academic demands and access to tangible items. However, because the results of a previously conducted informant assessment suggested that tangibly maintained aggression was more common at the group home, the focus of this study was limited to the tangible function. Tina's mean percentages of intervals with interruptions during the functional analysis were 42% and 5% in the attention and control conditions, respectively, indicating an attention function. During the NCR evaluation, Sam's mean rates of aggression were 0.69 during baseline, 0.45 during NCR, and 0.12 during NCR/S. Tina's mean percentages of intervals with interruptions were 48% during baseline, 30% during NCR, and 4% during NCR/S.

These results suggest that the addition of a verbal statement and timer signaling when a reinforcer will be delivered may increase the behavior-reduction effects of NCR. These results are notable because they demonstrate that a simple procedural variation of NCR may produce better outcomes than NCR alone. Practically, the procedural variation employed in this study might be attractive to many caregivers, because it involves providing additional information to clients as part of the treatment. However, the procedure does require more activity on the part of the therapist than does NCR alone.

One limitation of the current study is that the results for Sam were not as clear as those for Tina. That is, rates of aggression during Sam's signaled NCR phases were not substantially different than rates of aggression during his second NCR phase. In addition, the frequency of Sam's aggression during NCR phases (particularly the first phase) was only slightly lower than in baseline. This might be because the mean latency to the first response (the method used to derive the FT schedule value) resulted in an FT schedule that was similar to the rate of reinforcement during baseline. Prior research has shown that FT schedules reduce behavior best when the rate of FT reinforcer delivery is dissimilar from reinforcement rate in baseline (Ringdahl, Vollmer, Borrero, & Connell, 2001). Future researchers should ensure that FT schedules are sufficiently dense to reduce behavior.

The present findings, and those of Mace et al. (1998), are consistent with previous research that suggests that signaling changes in activities may be associated with reductions in problem behavior. For example, Flannery and Horner (1994) found that signaled (predictable) events were associated with less problem behavior than unsignaled (unpredictable) events during instruction for 2 children with developmental disabilities. Further, Vollmer, Borrero, Lalli, and Daniel (1999) demonstrated that signaled delays to reinforcement of alternative behavior were more effective in reducing aggression than were unsignaled delays.

The mechanisms responsible for the effects of the signal are unknown. The verbal statement delivered as part of the signaled NCR procedure may have indicated that the absence of the toy or attention was only temporary, possibly implicating rule governance as a behavior-change mechanism. Conversely, the visible timer may have simply functioned as an S delta. Future research might explicitly examine the mechanisms that are responsible for the effects of NCR plus signals.

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